

What is claimed is:

1. A system for launching a projectile to remove a body of rock in an excavation, comprising:

a projectile that includes:

a nose, the nose being one of substantially flat and concave to inhibit deflection of the projectile from a face of the rock;

a body containing an explosive charge; and

a tail having a plurality of transversely oriented fins to control the trajectory of the projectile; and

a tube for launching the projectile.

2. The system of Claim 1, wherein the body contains a detonating device, the detonating device having a primer in a proximal end and a striker in a distal end, the striker and primer being separated from one another by a spring member which forces the striker away from the primer and a safety pin which restricts the motion of the striker towards the primer.

3. The system of Claim 1, wherein the tube includes a cavity at a bottom of the tube for containing a propelling charge for launching the projectile from the tube.

4. The system of Claim 3, further comprising:

a pusher plate located between the propelling charge and the bottom of the projectile, the top of the pusher plate being in contact with the bottom of the projectile for pushing

5 the projectile out of the tube when the propelling charge is ignited.

10 5. The system of Claim 4, wherein the clearance between the outer perimeter of the pusher plate and the inside of the tube is relatively small to substantially seal gases from the ignited propelling charge in the cavity and thereby form a gas pressure differential on opposing sides of the pusher plate, with the gas pressure on the bottom of the pusher plate being greater than the gas pressure on the top of the pusher plate.

15 6. The system of Claim 4, wherein the bottom of the pusher plate is concave.

7. The system of Claim 1, wherein the explosive is selected from the group consisting of TNT, PETN, RDX, HMX, ammonium nitrate-based explosives, and mixtures thereof.

8. The system of Claim 1, wherein the tube includes a receiver/transmitter for receiving a control signal from a transmitter and transmitting a second control signal to a receiver in the projectile.

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9. A projectile for removing a body of rock in an excavation, comprising:

a nose at the front of the projectile;

5 a body located behind the nose and containing a detonating device and an explosive charge, the detonating device including a detonator to detonate the explosive charge and being located in a pocket having at least one of a length and width that exceeds a corresponding one of the length and width of the detonating device, thereby permitting at least
10 one of longitudinal and latitudinal motion of the detonating device in the pocket in response to movement of the projectile; and

15 a tail located behind the body and having a plurality of transversely oriented fins to stabilize the trajectory of the projectile.

10. The projectile of Claim 9, wherein the nose is at least one of substantially flat and concave to inhibit deflection of the projectile from a face of the rock.

11. The projectile of Claim 9, wherein the outer diameter of the body is no less than about 25% and no more than about 100% of the outer diameter of the tail.

12. The projectile of Claim 9, wherein the body has an outer wall composed of plastic.

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13. The projectile of Claim 9, wherein the tail has a length and the length is at least about 60% of the total length of the projectile.

14. The projectile of Claim 12, wherein the thickness of the outer wall ranges from about 1 to about 6 mm.

15. The projectile of Claim 9, wherein the body includes a plurality of ribs located beneath and supporting the explosive charge and wherein the number of ribs is at least 6.

16. The projectile of Claim 9, wherein the center of gravity of the projectile is located in the body and the center of pressure of the projectile is located in the tail.

17. The projectile of Claim 9, further comprising at least one receiver unit for receiving a control signal from a transmitter and for pre-arming, arming, or detonating the detonating device.

18. The projectile of Claim 9, further comprising a counter to determine a time interval after the firing of the projectile from a firing tube and provide a control signal to fully arm the detonating device.

5 19. The projectile of Claim 9, further comprising a counter to determine a time interval after the firing of the projectile from a firing tube and provide a control signal to detonate the detonating device.

20. The projectile of Claim 9, wherein the pocket has a width that is at least about 65% and no more than about 95% of the width of the detonating device volume.

21. The projectile of Claim 9, wherein the length of the pocket ranges from about 75 to about 100% of the length of the detonating device.

22. The projectile of Claim 9, wherein the width of the detonating device is less than the width of the pocket.

23. The projectile of Claim 9, wherein the gap between a sidewall of the detonating device and a sidewall of the pocket ranges from about 0.5 to about 4.0 mm.

24. The projectile of Claim 9, wherein a gap exists between an inner wall of the pocket and an outer wall of the detonating device and the gap ranges from about 0.5 to about 4.0 mm.

25. The projectile of Claim 9, wherein the detonating device has a primer and the detonator in a proximal end and a striker in a distal end, the striker and primer being separated from one another by a spring member which forces the striker away from the primer and a safety pin which restricts the motion of the striker towards the primer.

26. The projectile of Claim 9, wherein a distal end of the detonating device has a larger outer diameter than a proximal end of the detonating device such that the proximal end of the detonating device can be received along

substantially the entire length of the pocket and the distal
end of the detonating device cannot be received along
substantially the entire length of the pocket.

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27. A method for removing a body of rock in an excavation, comprising:

aiming a launch tube containing a projectile such that the projectile impacts a target area on the body of rock after launching;

transmitting a control signal to a receiver from a remote location to cause at least one of the following to occur: launching of the projectile and arming of the projectile;

launching the projectile from the tube; and

contacting the nose of the projectile with the target area.

28. The method of Claim 27, further comprising:

when the projectile is launched, transmitting a second control signal to a counter;

when the counter determines that a predetermined time interval is reached, generating a third control signal to perform at least one of the following steps:

arming a detonating device in the projectile and

initiating the detonating device to ignite an explosive charge in the projectile.

29. The method of Claim 27, wherein further comprising;

moving a striker in a detonating device in the projectile forwardly against a resistance of a spring member; and

impacting a primer with the front portion of the striker to initiate the primer, thereby initiating a detonator and

thereby initiating an explosive charge contained in the projectile.

5 30. The method of Claim 27, wherein further comprising; converting the control signal into electrical energy and when a predetermined amount of electrical energy is generated in the converting step, transmitting the electrical energy to a firing device to initiate the launching step.

5 31. The method of Claim 27, wherein further comprising; converting the control signal to electrical energy and when a predetermined amount of electrical energy is generated in the converting step, transmitting the electrical energy to activate a device to pre-arm or arm an ignition device in the projectile.

32. The method of Claim 27, wherein a velocity of the projectile during flight ranges from about 25 m/sec to about 250 m/sec.

33. The method of Claim 27, wherein the nose of the projectile is blunt to inhibit deflection of the projectile from angled surfaces.

34. The method of Claim 27, wherein the aiming step comprises positioning a radiation emitting device on the tube and thereafter aligning a beam of radiation from the radiation emitting device with the target.

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5 35. A method for removing a body of rock in an excavation, comprising:

 aiming a launch tube containing a projectile such that the projectile impacts a target area on the body of rock after launching;

10 launching the projectile from the tube;

 when the projectile is launched, transmitting a control signal to a counter; and

 if the counter determines that a predetermined time interval has elapsed, generating a second control signal to
15 initiate the detonating device to ignite an explosive charge in the projectile.

 36. The method of Claim 36, further comprising transmitting a third control signal to a receiver from a remote location to cause at least one of the following to
20 occur: launching of the projectile and arming of the projectile.